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Gaussian Beam Optics

Examples

The two most common operations done on laser beams are focusing and collimating. In the first example set, we consider the techniques used to focus laser beams at widely disparate focal distances, making use of the equations

[Focusing a Laser Beam](#)
[Collimating a Diode Laser](#)

$$w_F = \frac{\lambda f M^2}{\pi w_L}$$

to determine the focused spot size,

$$w(z) = w_0 \left[1 + \left(\frac{\lambda z M^2}{\pi w_0^2} \right)^2 \right]^{1/2}$$

to determine the beam radius at some arbitrary point in space, where w_F is the radius of the beam at the focus, and w_L is the radius of the beam at the focusing lens. (This assumes that the beam entering the lens is collimated.) M^2 can be assumed to be unity for a theoretical Gaussian beam.

The equation

$$w_0(\text{optimum}) = \left(\frac{\lambda z M^2}{\pi} \right)^{1/2}$$

is obtained by differentiating the previous equation with respect to distance and setting the result equal to zero. Remember that, in this equation, $w(z)$ and w_0 are the radii of the real-world beam, not the theoretical Gaussian.

In the second example set, we discuss the problems associated with collimating the highly astigmatic beam of a typical diode laser.

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